Ozone loss In the Arctic winter 2014/2015

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Objectives and Method

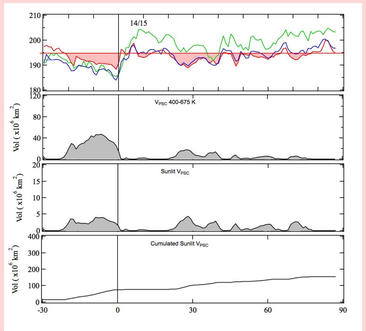
Quantification of chemical total ozone loss inside Vortex by comparison between modeled passive ozone and measurements

MODELS
3D CTM
initialized on December 1, 2014 from ECMWF ozone fields
=> REPROBUS (ECMWF, 1000 - 0.1 hPa)
=> SLIMCAT (ECMWF, 1000 - 0.3 hPa)

2 runs: a) Passive Ozone
b) Full chemistry

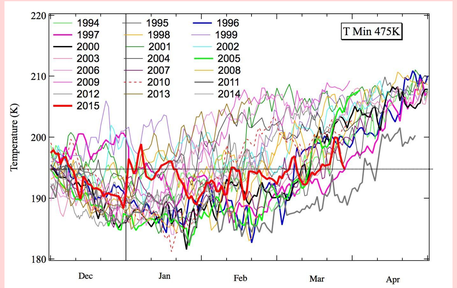
MEASUREMENTS
Total ozone => SAOZ/NDACC UV-Visible network
Twice daily at twilight

1- METEOROLOGY



- T<Tnat from Dec 10 to Dec 31 at 475K and 550K
- Large sunlit V_{PSC} from Dec 10 to Dec 31
- Sporadic cooling below Tnat and V_{PSC} in Jan-Mar until March 20

Comparison to previous winters

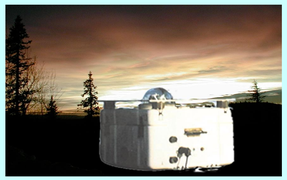


- Sudden warming on Jan 1 followed by progressive cooling
- Cold period in March compared to other winters
- Final warming after March 20

UV-Visible SAOZ

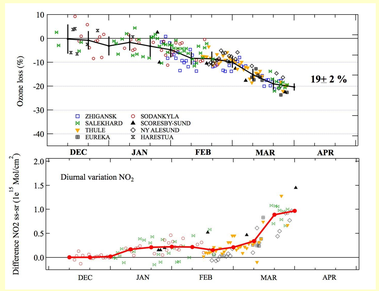
- Zenith sky UV-visible spectrometer
- Differential Optical Absorption Spectroscopy
- Ozone: Chappuis bands (450-550 nm)
- Consistency between stations: 3% (NDACC Intercomparisons)
- PSC days removed using a color index



UV-Visible SAOZ network

2- SAOZ OBSERVATIONS
Ozone loss and denitrification

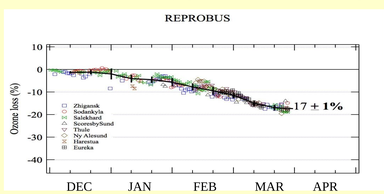


Top
-Evolution of ozone loss above SAOZ stations inside vortex

Bottom
Difference between sunset and sunrise NO2 columns inside vortex

- Small ozone depletion rate of 0.3% / day between Jan 10 and Feb 10
- Stopped between Feb 10 and Feb 28
- Restarted to 0.5% / day between Mar 1-March 20
- Stopped on March 20
- NO2 diurnal increase and chlorine deactivation after March 10
- Total cumulated loss of 19 ± 2% close to Arctic Spring average

4- MODEL LOSS ABOVE SAOZ STATIONS



REPROBUS: 17 % ~ 89 DU

REPROBUS timing:
- 0.15%/ day from Jan 1 up to March 1
- 0.5%/day from March 1 up to March 15
- Stopped on March 20

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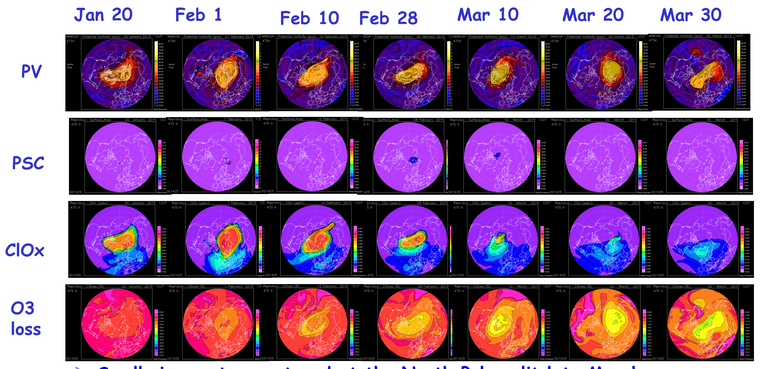
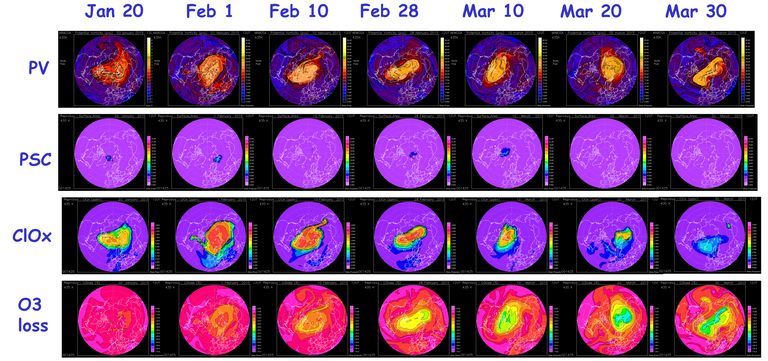
3- MIMOSA PV FIELDS AND REPROBUS 3D CTM SIMULATION (475 K)



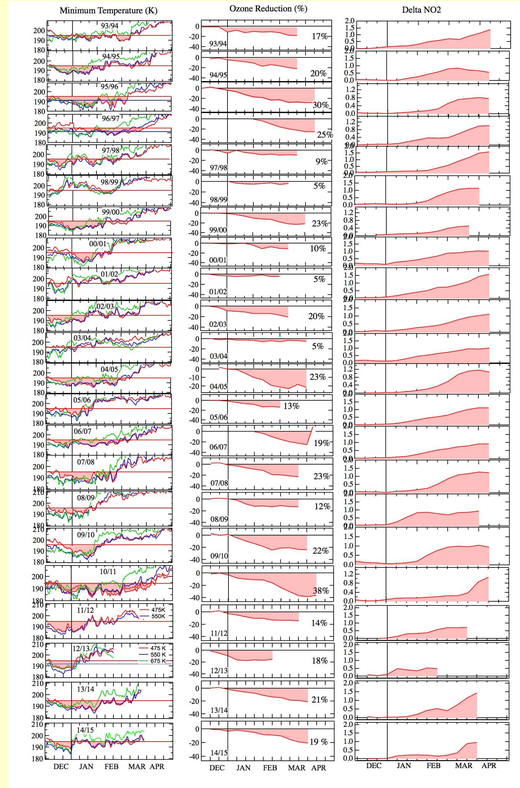
- Small size vortex centered at the North Pole unlit late March
- Few PSC only in early and late Feb at the Pole
- Chlorine activated until mid- Feb, deactivating progressively
- Ozone loss start in early Feb only, propagating until end of March

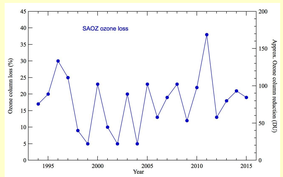
SIMULATION (435 K)



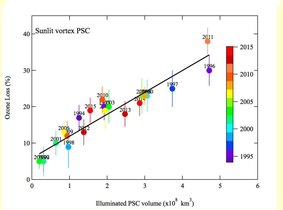
- Much more PSC, chlorine activation and ozone loss up to 50% at lower altitude at 435 K in late illuminated vortex in March

5- COMPARISON TO PREVIOUS WINTERS





2015 ozone loss close to Arctic winter mean loss since 1994



2015 ozone loss consistent with sunlit PSC volume relationship

CONCLUSION WINTER 2014/2015:

- Long lasting vortex
- Total ozone loss of 19% close to average depletion in the Arctic
- 19% loss due to vortex duration until March 20
- Less de-activation at lower altitude (435 K)
- Maximum destruction at lower altitude (435 K) than usual (475-550 K)